

Perioperative morbidity and complications in minimal access surgery techniques in obese patients with degenerative lumbar disease

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Abstract The medical profession is increasingly confronted with the epidemic phenomenon of obesity. Its impact on spine surgery is not quite clear. Published data concerning the use of minimally invasive surgery (MIS) in the spine among obese patients is scarce. The purpose of the present retrospective study was to evaluate perioperative as well as postoperative complication rates in MIS fusion of the lumbar spine in obese, overweight and normal patients classified according to their body mass index. Lumbar MIS fusion was performed by means of TLIF procedures and/or posterolateral fusion alone. A laminotomy was performed in patients with spinal stenosis. Of 72 patients, 39 underwent additional laminotomy for spinal stenosis. No differences were registered in respect of the numbers of fused segments or cages. Any harmful event occurring peri- or postoperatively was noted and included in the statistical analysis. No infection at the site of surgery or severe wound healing disorder was encountered. We registered no difference in blood loss, drainage, or the length of the hospital stay between the three BMI groups.

We also observed no difference in complication rates between the three groups. This study confirms the low soft tissue damage of minimal access surgery techniques, which is an important type of surgery in obese patients. The smaller approach helps to minimize infections and wound healing disorders. Moreover, deeper regions of wounds are clearly visualized with the aid of tubular retractors.

Keywords Minimally invasive spinal surgery · Degenerative lumbar disease · Obesity · Complications

Introduction

Obesity was a rare phenomenon until the twentieth century. From 1997 on, obesity has been identified as a global epidemic by the WHO [1]. In the years that followed, up to 6% of total health care costs and equally high indirect costs due to lost productivity were attributed to obesity and its associated illnesses [2]. In Austria up to 43% of the male population is considered overweight while 12% are considered obese. The largest number of overweight persons is found among the 60- to 74-year-olds (Statistical Bureau of Austria). Obesity is associated with a high risk of perioperative and postoperative complications [3–5].

The large wound surface in the obese is possibly the reason for perioperative morbidity. Minimally invasive spine surgery (MIS) is believed to provide a smaller corridor to the spine and results in less soft tissue injury. MIS procedures are associated with less blood loss, faster recovery, and less perioperative morbidity while yielding similar results as those after open procedures [6–9]. The purpose of the present study was to evaluate perioperative morbidity in lumbar fusions performed by the MAST technique in obese and non-obese patients.

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Patients and methods

After obtaining approval for the study from the ethics committee, 72 patients were recruited for this retrospective investigation. Written informed consent was obtained from all patients and the study was registered under <http://www.clinicaltrials.gov>, ID No. NCT01195584. Lumbar MIS fusion was performed by means of TLIF procedures and/or posterolateral fusion alone. In cases of spinal stenosis, a laminotomy was performed.

Obesity was classified according to the body mass index (BMI) established by the WHO. BMI is calculated by dividing the subject's mass by the square of the person's height ($BMI = \text{kg}/\text{m}^2$). Persons with a $BMI < 25$ are considered to be of normal weight, those with a $BMI > 25$ and < 30 overweight, while those with a $BMI > 30$ are considered obese.

Any harmful event occurring during surgery or postoperatively was noted and included in the statistical analysis.

Surgical technique

Revision of the disc space and laminotomy for spinal stenosis were performed using the Quadrant tubular retractor system (Medtronic Inc., Memphis, TN). After identifying the relevant facet joint by fluoroscopy, an incision was made 1.5 cm off the midline. A tube was inserted subcutaneously and muscle tissue was sequentially dilated by producing a corridor to the facet joint, in a similar fashion as described by Foley [10]. A tubular retractor was then inserted. The facet joint and the yellow ligament were exposed. The percutaneous fusion system Sextant II or Longitude (both Medtronic Inc., Memphis, TN) was used for posterolateral fusion. In cases of a 360° fusion, a TLIF procedure was performed [11]. In cases of stenosis the retractor was directed to the contralateral side of the spinal canal in order to perform a laminotomy [12].

Results

Of 72 patients, 30 were male and 42 female: Their mean age was $61.8 \text{ years} \pm 13.1 \text{ years}$. Twenty patients were of normal weight, 25 were overweight and 27 were obese (Table 1).

Patients of normal weight were significantly younger (54 years) than overweight or obese patients (67 and 63 years, respectively; $p = 0.001$). Smokers were more numerous among those of normal weight (53%) than in the other two groups (12% each; $p = 0.001$). The three BMI groups were well matched in terms of gender ($p = 0.323$).

A difference was registered with regard to previous surgery in the spine: 45% of patients of normal weight

(9/20 patients), and only 12% of the overweight (3/25 patients) and 8% of the obese (2/26 patients) had undergone previous surgery in the spine ($p = 0.005$). In respect of comorbidities, a difference was found in the prevalence of hypertension and hypothyroidism: 63% of obese patients (17/27), 48% of the overweight (12/25), and only 20% (4/20) of those of normal weight ($p = 0.013$) had hypertension. Eight of 27 obese patients (30%) and two of 25 overweight patients (8%) suffered from hypothyroidism, whereas no patient in the normal-weight group had this condition. Most other comorbidities were quite rare and were not expected to differ significantly in the above mentioned groups. Hepatic steatosis, hepatopathy or goiter were found in five cases, coronary artery disease in four, atrial fibrillation and cardiomyopathy in two, and type 1 diabetes in one case (Table 1).

The median number of fused segments was 2 (range 1–6), and the median number of cages two (range 0–4). The median duration of surgery was 165 min (range 79–389). The median blood loss and drainage in the postoperative monitoring-period was 119.5 ml (range 0–1,300).

With regard to operating times, a difference was registered between the groups ($p = 0.047$). Mean operating times were 157 min for patients of normal weight and 205 min for obese patients ($p = 0.014$). The operating time for overweight patients was between these two time periods and did not differ significantly from the two. Operating times were longer in patients who underwent two or three laminotomies (233 min) than in those who received no or one-level laminotomy (169 and 154 min, respectively; $p < 0.001$). Blood loss did not differ in relation to the number of widened levels ($p = 0.367$) (Table 2).

Laminotomy for stenosis was performed in 39 patients. Of these, 17 had a widening of the spinal canal at one level, 20 patients at two levels and 2 patients at three levels. We observed differences in the numbers of laminotomies between groups. The number of levels which needed to be widened differed between normal-weight, overweight and obese patients ($p = 0.022$). Eleven of 27 obese patients (41%) required a laminotomy at two or three levels, whereas only seven of 25 overweight patients (28%) and four of 20 normal-weight patients (18%) needed a laminotomy at two or three levels. Patients who underwent two- or three-level laminotomies were older (mean ages: 68.1 years for two-level and 67.8 years for three-level laminotomies) than patients who underwent no laminotomy (mean age, 54.5 years; $p < 0.001$). No differences were registered between the three BMI groups in respect of the number of fused segments, the number of cages, blood loss, drainage, or the duration of the hospital stay. The day of discharge could not be elicited for one patient from the medical records (Table 2).

Table 1 Demographics, pre-existing conditions and comorbidities in the study population

BMI	<25	25–30	≥30	Total
Number of patients	20 (27.8%)	25 (34.7%)	27 (37.5%)	100 (100%)
Prior spinal surgery	9	3	2	14
Hypertension	4	12	17	33
Hypothyroidism	0	2	8	10
Hepatic steatosis/hepatopathy/goiter	1	2	2	5
Coronary artery disease	1	1	2	4
Atrial fibrillation	0	1	1	2
Cardiomyopathy	0	2	0	2
Diabetes mellitus, type I	0	0	1	1

BMI < 25 (normal weight), BMI 25–30 (overweight) and BMI ≥ 30 (obese)

Table 2 Operation data and numbers of laminotomies in the BMI groups

BMI	<25	25–30	≥30	Number of patients (n)
Duration (min)	156.8 ± 41.6	186.2 ± 67.8	205.4 ± 76.0	72
Blood loss (ml)	165.4 ± 306.5	284.4 ± 375.1	169.8 ± 175.0	72
Number of segments	1.9 ± 0.8	2.3 ± 1.4	2.2 ± 1.1	72
Cages	1.8 ± 0.8	1.6 ± 1.2	2.1 ± 1.2	72
Drainage (ml)	165.6 ± 246.8	150.4 ± 125.6	152.0 ± 141.5	72
No laminotomy	15	9	9	33
1 level laminotomy	1	9	7	17
2 or 3 level laminotomy	4	7	11	22
Hospital discharge (days)	8.4 ± 2.17	11.2 ± 8.67	10.7 ± 3.51	71

No surgical site infection or severe wound healing disorder was encountered. One small dehiscence, a small necrosis of the margin, and five regional hematomas were noted; all of these were of no relevance in terms of therapy. Leakage of cerebrospinal fluid was noted in 10 patients (13.9%).

One patient with an epidural hematoma (1.4%) needed revision on the fourth postoperative day. A further patient required revision because of a malpositioned rod, which had not passed the lowest screw's tulip. Two complications related to osteoporosis were observed (2.8%), but were unrelated to the surgical technique.

Fever was the most common complication in the postoperative period and was observed in 15 patients. Of these, 12 patients had subfebrile temperatures. One patient developed neurogenic deficits, which persisted for a few months. The following were observed in one patient each: temporary meningism, pulmonary embolism, a transient ischemic attack, and cardiac ischemia. Three patients came down with a urinary tract infection, one with a respiratory tract infection and one with pneumonia.

No differences were observed between the three BMI groups in respect of wound healing disorders or complications (Table 3).

No significant difference was noted in respect of drainage or the possibility of greater blood loss in patients taking NSAIDs until surgery.

Table 3 Postoperative complications in the BMI groups and the entire patient population

BMI	Postoperative complication rate			
	<25	25–30	≥30	Total
Fever	3	3	9	15
Subfebrile	3	3	6	12
Neurogenic deficit	0	1	0	1
Temporary meningism	1	0	0	1
Pulmonary embolism	0	0	1	1
Transient ischemic attack	0	1	0	1
Cardiac ischemia	0	0	1	1
Urinary tract infection	1	0	2	3
Respiratory infection	0	1	0	1
Pneumonia	0	0	1	1

Patients were divided into those <65 years and those ≥65 years of age. Operating times ($p = 0.049$) and the quantity of blood loss ($p = 0.039$) increased with age. However, no significant differences were observed between the age groups in respect of complication rates.

Discussion

The impact of obesity on complications in spine surgery is not quite clear. Some authors report no difference in

complication rates between obese patients and those of normal weight [13–15]. Nevertheless, the fact remains that obesity is a problem of significant magnitude in surgery [3, 5, 16–18].

Patel investigated a cohort consisting of 84 patients (60 treated by the open technique and 24 by minimally invasive procedures). This group was confined to patients with symptomatic degenerative conditions in need of an anterior, posterior, or combined antero-posterior fusion [3]. Patel addressed the probability of significant complications related to BMI ($p = 0.04$): the chances of significant complications were 14% in patients with a BMI of 25, 20% in those with a BMI of 30, and 36% in those with a BMI of 40. Telfeian [5] noted a high complication rate (50%), but good overall outcomes in a small series of morbidly obese patients.

Wound infection rates are believed to be higher in obese patients, but the reported data range from 0 to 33% [5, 13, 14, 16, 17]. Olsen [18] showed that obesity as well as the posterior approach was associated with a high risk of spinal surgical site infection in patients undergoing laminectomy and/or spinal fusion. Djurasovic [19] studied 109 obese patients and 161 non-obese patients undergoing single or multilevel lumbar spinal fusion for a variety of degenerative lumbar spine conditions, such as spondylolisthesis, spinal stenosis, lumbar instability, and degenerative disc disease. He registered higher complication rates in the obese group ($p = 0.045$), principally due to wound-related complications (5.5%). Friedman analyzed 41 patients with surgical site infection complicating laminectomy and 82 matched controls [20]. He found a BMI greater than 35 [OR, 7.1 (95% CI 1.8–28.3); $p = 0.005$], and laminectomy at a level other than the cervical spine [OR, 6.7 (95% CI, 1.4–33.3); $p = 0.02$] to be independent risk factors for surgical site infection after laminectomy. Gepstein [16] evaluated 298 patients older than 65 years undergoing decompressive laminectomy, discectomy or a combination of these procedures. He noted that patients with a BMI > 25 had significantly more complications (89 patients with a BMI > 25 versus 33 patients with a BMI ≤ 24.9 , $p = 0.02$). Wound infections occurred in 9% of overweight and obese patients.

Cole [21], using a similar tubular retractor system as in our study, assessed patient outcomes and complication rates after minimally invasive lumbar microdiscectomy in 32 obese patients with a body mass index of 30 or more, and encountered no infectious complications in the study population.

Park evaluated 56 patients with a mean BMI of 31.5 using a minimally invasive tubular retractor system. In cases of fusion, TLIF was used in conjunction with posterolateral fusion via paramedian incisions [12]. Thirty-one of the 56 patients underwent either discectomy or

decompressive laminotomy; the remaining 25 patients underwent single-level or two-level spinal fusion. Again, no infection was encountered.

We observed no severe wound healing disorders in our study sample.

MIS fusion procedures are associated with less blood loss, faster recovery, and less perioperative morbidity while yielding similar results as those after open procedures [6–8]. The reason for this is presumably the smaller corridor to the spine, which causes less tissue trauma. Enzymes indicative of muscle damage as well as inflammatory cytokines are lower in patients who have undergone mini-open fusion rather than open procedures [22]. Nevertheless, the benefits of spinal MIS fusion procedures in obese patients have been poorly investigated.

The most frequent intraoperative complication in our sample was leakage of cerebrospinal fluid (13.9%). Telfeian [5] reported a durotomy rate of 16.7% for spinal surgery in the morbidly obese. All leakages were closed during the same surgical session as far as possible, and the patients were advised to remain supine for 2.5–5 days. Until completion of the present study no patient experienced an adverse consequence due to leakage. Cole performed minimally invasive lumbar discectomies in 32 obese patients and reported incidental durotomy as the most common complication (9.4%). He attributed this to the greater working distance in overweight patients [21]. In contrast, we registered no significant difference in the occurrence of dural tears in our 3 BMI groups.

We made a distinction between minor and major post-operative complications, as did Carreon [23]. Carreon classified the following as major complications: wound infection (10%), pneumonia (5%), renal failure (5%), myocardial infarction (3%), respiratory distress (2%), neurologic deficit (2%), congestive heart failure (2%) and cerebrovascular accident (1%). Minor complications were urinary tract infection, anemia requiring transfusion, confusion, ileus, arrhythmia, transient hypoxia, wound seroma, and leg dysesthesia.

We observed one pulmonary embolism (1.4%), one transient ischemic attack (1.4%) one cardiac ischemia (1.4%), one pneumonia (1.4%), and one patient with a neurogenic deficit (1.4%). These amounted to five major complications (6.9%). Again, no statistical difference was registered between the three BMI groups.

Fever was observed in 15 patients. Of these, 12 had subfebrile temperatures. Subfebrile temperatures ranged between 37.5 and 38.0°C, whereas a body temperature above 38.1°C was defined as fever. Temperature is ultimately regulated in the hypothalamus. A trigger of the fever, called a pyrogen or cytokine, causes the release of prostaglandin E2 (PGE2). PGE2 then, in turn, acts on the hypothalamus, which generates a systemic response to the

rest of the body, causing thermic effects to match the new temperature level. Fever is a common phenomenon in the early postoperative period fever, being the consequence of an inflammatory event. As endogenous cytokines (interleukin-1, interleukin-6) are released even after minor trauma, we viewed fewer as no cause of concern among our patients. We found no connection between fever and obesity.

In the published literature, some authors have reported longer operating times for MIS procedures [6, 7, 24], others an equivalent [8], and yet others shorter operating times [25] than those required for open surgery. In our group, mean operating times were 157 min in patients of normal weight and 205 min in the obese. One explanation could be the fact that longer retractor blades are needed to cover the longer distance to the spine and the longer tubes are difficult to handle. Moreover, the more numerous levels require additional laminotomies, which, in turn, prolong the operating time. We registered longer operating times ($p = 0.049$) and greater blood loss ($p = 0.039$) with advancing age. This may have been due to the fact that elderly patients require laminotomies at more numerous levels in cases of spinal stenosis. However, we did not register greater blood loss in these patients.

Revision surgery was required because of one malpositioned rod and one epidural hematoma (each 1.4%). The frequency of postoperative epidural hematomas has not been extensively reported. In a review of 16 articles, Glotzbecker [26] found clinically relevant epidural hematomas in no more than 1% of cases. We registered a similar rate in our study.

In conclusion, the frequency of adverse events after MIS spine surgery does not differ from that after open procedures. MIS techniques would seem to benefit obese patients because of the smaller access and less tissue trauma compared to open techniques. The gentler handling of soft tissue may have been the reason for the absence of infections in our sample.

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Conflict of interest None.

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